

CLAIMS

1. A method for producing a cyclic lactic acid oligomer, which comprises:

(i) a first heating process for dehydration condensation of lactic acids by heating, which comprises dehydration condensation of lactic acids under conditions of a pressure and a temperature which allow by-product water to be removed by distillation while avoiding distillation of lactides; and

(ii) a second heating process for generating a dehydrated condensate of lactic acid, which comprises heating the reaction product from said first heating process to a temperature higher than that of the first heating process, reducing the pressure to 100mmHg or lower under conditions of a pressure and a temperature which allow by-product water to be removed by distillation while avoiding distillation of lactides, and further continuing the reaction by heating under the reduced pressure.

2. The method for producing a cyclic lactic acid oligomer according to claim 1, wherein in the first heating process (i), lactic acids are subjected to dehydration condensation reaction by heating to a temperature of 150°C or lower under a pressure of 10 to 760mmHg.

3. The method for producing a cyclic lactic acid oligomer according to claim 1 or 2, wherein in the first heating process (i), lactic acids are subjected to dehydration condensation reaction by heating to a temperature ranging from 120°C to 140°C under a pressure of 350 to 400mmHg.

4. The method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 3, wherein in the second heating process (ii), the reaction product from the first heating process is heated to 145°C or higher, the reaction pressure is reduced to 100mmHg or lower at a depressurization rate of 0.5 to 1mmHg/min, and the reaction is further continued under the reduced pressure and at a temperature of 145°C or higher so as to generate a dehydrated condensate of lactic acid.

5. The method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 4, wherein in the second heating process (ii), the reaction product from the first heating process is heated to 150°C to 160°C, and while the reaction pressure is reduced to 15 to 20mmHg at a depressurization rate of 0.5 to 1mmHg/min, by-product water is removed by distillation while avoiding distillation of lactides, and after the reaction pressure is reduced to 15 to 20mmHg, the reaction is further continued under the same pressure and at a reaction temperature of 150°C to 160°C so as to generate a dehydrated condensate of lactic acid.

6. The method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 5, which further comprises:

(iii) a third heating process for generating a cyclic lactic acid oligomer, which comprises cyclization of a chain lactic acid oligomer in the reaction product from said second heating process by heating under a pressure lower than that of said second heating process.

7. The method for producing a cyclic lactic acid oligomer according to claim 6, wherein in the third heating process (iii), the reaction product from the second heating process is heated at 150°C to 160°C under a pressure of 0.1 to 5mmHg.

8. The method for producing a cyclic lactic acid oligomer according to claim 1, which comprises:

(i) a first heating process, which comprises heating lactic acids to a temperature ranging from 120°C to 140°C under a pressure of 350 to 400mmHg for dehydration condensation reaction, while removing by-product water by distillation, and avoiding distillation of lactides;

(ii) a second heating process, which comprises heating the reaction product from said first heating process to a temperature of 150°C to 160°C, reducing the reaction pressure

to 15 to 20mmHg at a depressurization rate of 0.5 to 1mmHg/min, removing by-product water by distillation while avoiding distillation of lactides, and after the reaction pressure is reduced to 15 to 20mmHg, further continuing the reaction under the same pressure and at a reaction temperature of 150°C to 160°C so as to generate a dehydrated condensate of lactic acid; and

(iii) a third heating process, which comprises cyclizing a chain lactic acid oligomer in the reaction product from said second heating process by heating at 150°C to 160°C under a pressure of 0.1 to 5mmHg so as to generate a cyclic oligomer.

9. The method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 8, wherein cyclic lactic acid oligomers are selectively produced while substantially no chain lactic acid oligomers are produced.

10. The method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 9, wherein the ratio of cyclic lactic acid oligomers to total lactic acid oligomers in the reaction product is 80% by weight or more.

11. A cyclic lactic acid oligomer produced by the method for producing a cyclic lactic acid oligomer according to any one of claims 1 to 10.

12. The cyclic lactic acid oligomer according to claim 11, which is substantially free of chain lactic acid oligomers.